

WE CLAIM:

1. A process for the preparation of a catalyst composition of the general formula, on an oxide basis,



wherein

X represents at least one non-noble Group VIII metal;

M represents at least one non-noble Group VIb metal;

Z represents one or more elements selected from aluminium, silicon, magnesium, titanium, zirconium, boron and zinc;

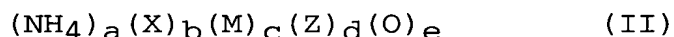
O represents oxygen;

one of b and c is the integer 1;

and

d, e, and the other of b and c each are a number greater than 0 such that the molar ratio of b:c is in the range of from 0.5:1 to 5:1, the molar ratio of d:c is in the range of from 0.1:1 to 50:1, and the molar ratio of e:c is in the range of from 3.6:1 to 108:1;

which comprises heating a composition of the general formula



in which a is a number greater than 0 and X, M, Z, O, b, c, d and e are as defined above, at a temperature in the range of from 100 to 600°C,

wherein the composition of general formula II is in the form of, or is recovered from, a slurry optionally after ageing at a temperature in the range of from 20 to 95°C for a minimum of 10 minutes, said slurry being obtained by (co)precipitating, at a temperature and for a time sufficient to produce the composition II, at least one non-noble Group VIII metal compound, at least one non-noble Group VIb metal compound, at least one refractory oxide material and an alkali compound, in a protic

liquid, at least one of the metal compounds being partly in solid state and partly in dissolved state.

2. A process as claimed in claim 1, wherein said heating of the composition II is at a temperature not exceeding 350°C.

3. A process as claimed in claim 2, wherein the (co)precipitation is carried out at a temperature in the range of from 25 to 95°C, for a period of time in the range of from 10 minutes to 2 hours, at an alkali concentration of from 0.2 mol per mol of metals M+X, on an oxide basis, to 50 mol per mol of metals M+X, on an oxide basis, and with an initial slurry concentration in the range of from 2 to 40 wt% nominal solids content.

4. A process as claimed in claim 3, wherein the alkali compound is ammonia or a material that will generate ammonium ions in the protic liquid used.

5. A process as claimed in claim 4, wherein the alkali concentration is in the range of from 0.75 to 5 mol nitrogen per mol of metals M + X, on an oxide basis.

6. A process as claimed in claim 5, wherein the composition of the general formula I is further subjected to any one or more of the following process steps carried out in any appropriate order: cooling; optionally isolating; drying; shaping, preferably by extrusion using no extrusion aids; calcining; sulphiding.

7. A bulk metal oxide catalyst composition obtainable by a process as claimed in any one of claims 1 to 6.

8. A catalyst comprising a composition of the general formula, on an oxide basis,



wherein

X represents at least one non-noble Group VIII metal;

M represents at least one non-noble Group VIb metal;

Z represents one or more elements selected from aluminium, silicon, magnesium, titanium, zirconium, boron and zinc;

O represents oxygen;

one of b and c is the integer 1;

and

d, e, and the other of b and c each are a number greater than 0 such that the molar ratio of b:c is in the range of from 0.5:1 to 5:1, the molar ratio of d:c is in the range of from 0.1:1 to 50:1, and the molar ratio of e:c is in the range of from 3.6:1 to 108:1;

which is prepared by a precipitation process wherein refractory oxide material in an amount in the range of from 15 to 40 wt%, on an oxide basis, is precipitated with at least one non-noble Group VIII compound and at least one non-noble Group VIb metal compound.

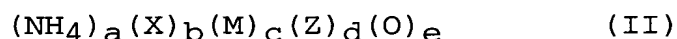
9. A catalyst as claimed in claim 8, wherein the metals X and M are one of nickel and molybdenum, nickel and tungsten, and nickel, molybdenum and tungsten.

10. A catalyst as claimed in claim 9, which is XRD-amorphous.

11. A catalyst as claimed in claim 10, which has an XRD diffraction pattern in which above $2\theta=15^\circ$, there is a local maximum having a characteristic full width at a half maximum above 2.5° at each of a 2θ value in the range of from 25.5° to 28.0° ; a 2θ value in the range of from 33.6° to 34.6° ; and a 2θ value in the range of from 59.8° to 62.2° , and there is no reflection or local maximum having a characteristic full width at half maximum of 2.5° or below.

12. A catalyst as claimed in claim 11, wherein X is nickel, M is molybdenum, Z is silicon; the molar ratio of X:M is 1:1 and the refractory oxide material is precipitated with the metals compounds in an amount in the range of from 15 to 30, preferably to 25 wt%.

13. A process for the preparation of a composition, said process comprises heating a composition of the general formula



in which a is a number greater than 0 and X, M, Z, O, b, c, d and e are as defined in claim 1, at a temperature in the range of from 100 to 600°C to yield said composition having the general formula, on an oxide basis,



wherein

X represents at least one non-noble Group VIII metal;

M represents at least one non-noble Group VIb metal;

Z represents one or more elements selected from aluminium, silicon, magnesium, titanium, zirconium, boron and zinc;

O represents oxygen;

one of b and c is the integer 1;

and

d, e, and the other of b and c each are a number greater than 0 such that the molar ratio of b:c is in the range of from 0.5:1 to 5:1, the molar ratio of d:c is in the range of from 0.1:1 to 50:1, and the molar ratio of e:c is in the range of from 3.6:1 to 108:1.

14. A method of making a composition, said method comprises:

mixing a non-noble Group VIII metal compound, a non-noble Group VIb metal compound, a refractory oxide material and an alkali compound in a protic liquid to thereby form a mixture in which said mixture at least one of the metal compounds is partly in solid state and partly in dissolved state;

subjecting said mixture to coprecipitation conditions thereby forming a coprecipitate solid; and

heating said coprecipitate solid at an elevated temperature so as to yield said composition.

15. A method as recited in claim 14, wherein said protic liquid comprises water, said non-noble Group VIB metal compound is either a molybdenum compound or a tungsten compound, said non-noble Group VIII metal compound is a nickel compound that suitably stays in the partly solid phase in said protic liquid, and said alkali compound is selected from the group consisting of hydroxides, silicates, and carbonates.

16. A method as recited in claim 15, wherein said coprecipitation conditions include maintaining said mixture at a coprecipitation temperature in the range of from 25 to 95 °C for a period of time in the range of from 10 minutes to 2 hours, and wherein said mixture includes an alkali concentration in the range of from 0.5 mol per mol of the non-noble Group VIII metal and non-noble Group VIB metal, on an oxide basis, to 50 mol per mol of the non-noble Group VIII metal and non-noble Group VIB metal, on an oxide basis.

17. A method as recited in claim 16, wherein said elevated temperature is in the range of from 100 °C to 600 °C.

18. A method as recited in claim 17, wherein said alkali compound is ammonia or a material that will generate ammonium ions in the protic liquid of said mixture.

19. A method as recited in claim 18, wherein said composition is of the general formula, on an oxide basis,



wherein

X represents at least one non-noble Group VIII metal;

M represents at least one non-noble Group VIB metal;

Z represents one or more elements selected from
aluminium, silicon, magnesium, titanium, zirconium,
boron and zinc;

O represents oxygen;

one of b and c is the integer 1;

and

d, e, and the other of b and c each are a number greater than 0 such that the molar ratio of b:c is in the range of from 0.5:1 to 5:1, the molar ratio of d:c is in the range of from 0.1:1 to 50:1, and the molar ratio of e:c is in the range of from 3.6:1 to 108:1.

20. A method as recited in claim 19, wherein said composition is XRD-amorphous.

21. A method as recited in claim 20, wherein said composition has an XRD diffraction pattern in which above $2\theta=15^\circ$, there is a local maximum having a characteristic full width at a half maximum above 2.5° at each of a 2θ value in the range of from 25.5° to 28.0° ; a 2θ value in the range of from 33.6° to 34.6° ; and a 2θ value in the range of from 59.8° to 62.2° , and there is no reflection or local maximum having a characteristic full width at half maximum of 2.5° or below.

22. A hydroprocessing method, comprising:
contacting under hydroprocessing conditions a hydrocarbon feed with a catalyst comprising a composition of the general formula, on an oxide basis,



wherein

X represents at least one non-noble Group VIII metal;

M represents at least one non-noble Group VIb metal;

Z represents one or more elements selected from
aluminium, silicon, magnesium, titanium, zirconium,
boron and zinc;

O represents oxygen;

one of b and c is the integer 1;

and

d, e, and the other of b and c each are a number greater than 0 such that the molar ratio of b:c is in the range of from 0.5:1 to 5:1, the molar ratio of d:c is in the

range of from 0.2:1 to 50:1, and the molar ratio of e:c is in the range of from 3.7:1 to 108:1.

23. A hydroprocessing method as recited in claim 22 wherein said composition is XRD-amorphous.

24. A hydroprocessing method as recited in claim 23 wherein said composition has an XRD diffraction pattern in which above $2\theta=15^\circ$, there is a local maximum having a characteristic full width at a half maximum above 2.5° at each of a 2θ value in the range of from 25.5° to 28.0° ; a 2θ value in the range of from 33.6° to 34.6° ; and a 2θ value in the range of from 59.8° to 62.2° , and there is no reflection or local maximum having a characteristic full width at half maximum of 2.5° or below.

25. A composition made by the method of claim 14.

26. A method comprising:
contacting under hydroprocessing conditions a hydrocarbon feed with the composition made by the method of claim 14.